PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-319507
(43)Date of publication of application : 24.11.1999

(51)Int.Cl. B01D 63/02
B01D 65/08
C02F 1/44

(21)Application number : 10-140677
(22)Date of filing : 22.05.1998

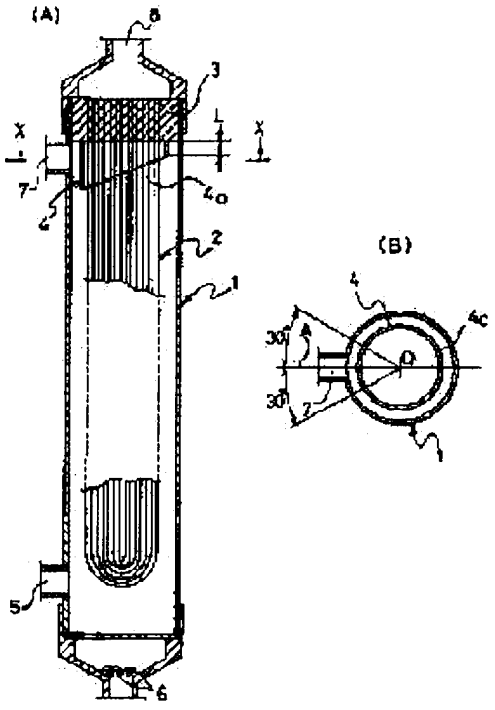
(71)Applicant : TORAY IND INC
(72)Inventor : SAKAI KENJI
TANIGUCHI MASAHIDE
KIHARA MASAHIRO

(54) HOLLOW FIBER MEMBRANE MODULE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a hollow fiber membrane module whose hollow fiber membranes are prevented from damages due to deterioration of the membranes by installing a protective cylinder for covering the hollow fiber membrane bundle near the adhesive fixation part and preventing deposition of suspended solid in the protective cylinder.

SOLUTION: In this hollow fiber membrane module, a bundle 2 of a large number of hollow fiber membranes having an adhesive fixed part 3 in at least one end is fixed in an upper part of a housing 1 and the circumference of the hollow fiber membrane bundle 2 in the fixed end is covered with a protective cylinder 4 extended from the adhesive fixed part 3 and an air jetting hole 6 for air scrubbing is formed in a lower part of the housing 1 and an air discharge port 7 is formed in the peripheral part of the adhesive fixed part 3 in the upper part of the housing. In such a hollow fiber membrane module, the cylindrical face of the protective cylinder 4 is made a closed face through which a fluid is impossible to pass in the region at least 10 mm from the adhesive fixed part 3 and an opening part 40 through which a fluid can freely pass is formed in a region of 10-60 mm from the adhesive fixed part 3.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the hollow fiber module which enables it to prevent deposition of the suspended solid near [this] the hollow fiber bunch fixed-end section etc., preparing a protection cylinder in the fixed-end section of a hollow fiber bunch in more detail about the hollow fiber module which performs liquid filtration operation while using air scrubbing together.
[0002]
[Description of the Prior Art] Since a very large filtration membrane area per unit volume can be taken, many hollow membrane modules which used the porous hollow fiber are applied as a means to remove the suspended solid in industrial water from the former. As a mode of such a hollow membrane module, from the air injection tip prepared in the housing lower part, when air is introduced periodically and carries out air scrubbing, a hollow fiber is vibrated, and there are some which removed the sediment of the film surface.
[0003] However, problems, like the hollow membrane module of the gestalt which uses this air scrubbing together closes an exhaust nozzle by damaging the fixed-end section of a hollow fiber, in order for introductory air to make near the fixed part of a hollow fiber bunch rock superfluously, and drawing a hollow fiber in the exhaust port of introductory air were also generated.
[0004] As a measure for such a problem, as shown in drawing 3 , the hollow membrane module which covered near the fixed-end section of a hollow fiber bunch by the protection cylinder of a cylindrical shape is proposed. The both ends of hollow **** 2 which bent this hollow fiber module in the shape of U are fixed to the adhesion fixed part 3, and the adhesion fixed part 3 is attached in the inside upper part of housing 1. Moreover, it is fixed so that the protection cylinder 4 may extend downward to the inside of the adhesion fixed part 3, and it is protected so that the circumference of the fixed-end section of the hollow fiber bunch 2 may be covered by this protection cylinder 4.
[0005] Moreover, many air injection tips 6 (nozzle) which introduce the air for air scrubbing into it while the feed hopper 5 of treated liquids, such as industrial water, is formed in the lower part of housing 1 are arranged annular. Moreover, the exhaust port 7 which makes drainage of a treated liquid and eccrisis of air serve a double purpose near the adhesion fixed part 3 is formed in the upper part of housing 1. Moreover, the output port 8 of filtered water is formed in the outside of the adhesion fixed part 3 of housing 1 edge.
[0006] By the above-mentioned hollow fiber module, since the fixed part of a upper limit is surrounded by the protection cylinder 4 and flexibility is restricted although the hollow fiber bunch 2 shakes if air scrubbing operation is carried out by injecting air from the air injection tip 6, a superfluous shake cannot reach to the fixed part to the adhesion fixed part 3, but can prevent the crease by shearing force etc. Moreover, a hollow fiber becomes that it is hard to be drawn in an exhaust port 7.
[0007] However, since the movement of adhesion fixed part 3 near [the hollow fiber bunch 2] will be extremely restricted even if it carries out air scrubbing if the protection cylinder 4 is formed in this way,

the suspended solid adhering to the filtration membrane side becomes being easy to deposit gradually, and when the sediment grows, the effective film surface product which contributes to filtration decreases gradually. Moreover, also in the usual filtration operation, in the portion which the sediment accumulated in the protection cylinder, a hollow fiber deteriorates and it comes to generate a hollow fiber piece.

[0008]

[Problem(s) to be Solved by the Invention] The purpose of this invention is to offer the hollow fiber module which prevents suspended-solid deposition within a protection cylinder, and prevented the injury by degradation of a hollow fiber, establishing the hollow fiber bunch near an adhesion fixed part for a wrap protection cylinder.

[0009]

[Means for Solving the Problem] The hollow fiber module of this invention fixes to the housing upper part the adhesion fixed part of the hollow fiber bunch of many numbers which fixed the end at least. The circumference of the fixed end of this hollow fiber bunch is covered by the protection cylinder extended from the aforementioned adhesion fixed part. In the hollow fiber module which prepared the air injection tip for air scrubbing in the aforementioned housing lower part, and prepared the air exhaust port near [an adhesion fixed part] the above of the aforementioned housing upper part while making the cylindrical surface of the aforementioned protection cylinder into the closed side [mm / at least 10 / from the aforementioned adhesion fixed part to] which a fluid cannot circulate -- the range of the aforementioned adhesion fixed part to 10-60mm -- circulation -- it is characterized by preparing free opening

[0010] thus -- although the protection cylinder which suppresses the shake at the time of air scrubbing of a hollow fiber is prepared in this invention -- the cylindrical surface from an adhesion fixed part to at least 10mm -- the closed side which a fluid cannot circulate -- carrying out -- the range of 10-60mm -- circulation -- since free opening was prepared, air ****** is formed in the field from an adhesion fixed part to at least 10mm within a protection cylinder It becomes in this air ******, without a hollow fiber's not deteriorating with a sediment near an adhesion fixed part, and a hollow fiber piece happening by the degradation, since a suspended solid does not accumulate.

[0011]

[Embodiments of the Invention] Drawing 1 (A) and (B) show an example of the hollow fiber module of this invention. The basic structure of a hollow fiber module is the same as conventional drawing 3 , pars intermedia is bent in the shape of U, and, as for hollow **** 2, both ends are being fixed to the adhesion fixed part 3. Thus, the adhesion fixed part 3 which fixed the hollow fiber bunch 2 is attached in the inside upper part of housing 1. Moreover, it is fixed to the inside of the adhesion fixed part 3 so that the protection cylinder 4 may extend downward, and the circumference of the fixed-end section of the hollow fiber bunch 2 is protected by the inside.

[0012] While the feed hopper 5 of a treated liquid is formed in the lower part of housing 1, the air injection tip 6 (nozzle) for air scrubbing is formed. The exhaust port 7 which makes drainage of a treated liquid and eccrisis of air serve a double purpose is formed in the upper part of housing 1 so that it may be located near the adhesion fixed part 3. The output port 8 for taking out the filtered water filtered by the hollow fiber bunch 2 is formed in the upper-limit section of housing 1 so that it may be located in the opposite side of the adhesion fixed part 3.

[0013] The above-mentioned protection cylinder 4 has a long cylindrical surface in the side which the soffit section is cut off aslant, therefore meets an exhaust port 7, and the cylindrical surface is short by the opposite side. The curtate distance L from the inside of the adhesion fixed part 3 is set as at least 10mm, the cylindrical surface of the protection cylinder 4 in this field turns into an all-over-the-districts closed side, and a fluid can move no longer this short cylindrical-surface side within and without a protection cylinder. Since a downward field is set to opening 4o from a curtate distance L, a fluid can carry out free movement within and without a protection cylinder. As a field of this opening 4o, it is set as the range of 10-60mm from the inside of the adhesion fixed part 3.

[0014] By forming the protection cylinder 4 of the above-mentioned composition, air **** is made in at

least 10mm tubed closed side field from the inside of the tubed closed side field 3 which consists of a curtate distance L, i.e., an adhesion fixed part. Since processed water does not exist at the time of the usual filtration operation, the suspended solid in raw water does not adhere to the film surface of a hollow fiber, and degradation of a hollow fiber does not take place to this air ****, either.
[0015] Moreover, from a curtate distance L, in downward opening 4o, since only few shakes are permitted restricting the superfluous shake of the hollow fiber bunch 2 at the time of air scrubbing in order that a fluid may move in and abroad freely, a suspended solid does not adhere to a film surface. Moreover, since a superfluous shake does not reach to the fixed end of the hollow fiber bunch 2, the crease by shearing force etc. can be prevented.
[0016] the segment which connects the cross-section center O of the protection cylinder 4, and the entrance center of an exhaust port 7 as above-mentioned opening 4o on the cross section of the protection cylinder 4 passing through the entrance center of an exhaust port 7 as shown in drawing 1 (B) -- it is desirable to make it exist in the portion of the protection cylinder except the field which attends right and left **30 degrees at a time from this center O to A By such arrangement of opening 4o, it can prevent effectively that a hollow fiber is absorbed by the exhaust port 7 at the time of air scrubbing.
[0017] Drawing 2 (A) and (B) show other operation gestalten of this invention. This operation gestalt consists of the same composition as drawing 1 , except that opening 4o prepared in the protection cylinder 4 constituted as the aggregate of two or more holes. From the inside of the adhesion fixed part 3, the distance from the inside of the adhesion fixed part 3 of opening 4o sets up the field in which a curtate distance L is set so that it may be at least 10mm, and opening 4o is prepared so that it may be the range of 10-60mm.
[0018] Similarly [in this operation gestalt / of drawing 1], since air ****** is made to the tubed closed side field which consists of a curtate distance L, the suspended solid in raw water does not adhere to the film surface of a hollow fiber, and degradation of a hollow fiber does not take place, either. Moreover, in opening 4o, since the superfluous shake of the hollow fiber bunch 2 at the time of air scrubbing is restricted in order that a fluid may move in and abroad freely, and only few shakes can be performed, a suspended solid not adhering to a film surface, and a superfluous shake attaining to the fixed end of the hollow fiber bunch 2, and causing the crease by shearing force etc. can also be prevented.
[0019] moreover, the segment which connects the cross-section center O of the protection cylinder 4, and the entrance center of an exhaust port 7 on the cross section of the protection cylinder 4 by which opening 4o passes along the entrance center of an exhaust port 7 as shown in drawing 2 (B) -- it is desirable to be arranged to A at the portion of the protection cylinder except the field which attends right and left **30 degrees at a time from this center O, and a hollow fiber is made not to absorb by this by the exhaust port 7
[0020] Many hollow fiber modules of this invention load with the porosity hollow fiber of a book into housing, and introduce the liquid of solid-liquid mixture in a module, and especially a configuration will not be limited if it is the structure which can do solid liquid separation according to a hollow fiber side. Generally, the structure of a hollow fiber bunch which carried out adhesion fixation of the end with housing with adhesives at least, cut the adhesion fixed part and carried out opening of the interior of a hollow fiber is used. what has arranged the hollow fiber in the shape of a straight line in housing, and fixed an end or ends with housing in this structure -- or what bundles a hollow fiber in the shape of U character, and fixes an end with housing like the operation gestalt of drawing 1 or drawing 2 is mentioned
[0021] Although especially the size of housing which constitutes the hollow fiber module of this invention is not limited, it is good for manufacture of a module to carry out expedient selection easily from the range whose length the viewpoint that modular handling is comparatively easy to the diameter of housing is 20-2500mm in about 50-600mm. As the quality of the material of housing, any of a metal and a resin are sufficient. As a resin, acrylic resin, vinyl chloride resin, a polysulfone, a deformation polyphenylene oxide, polycarbonate resin, etc. are preferably suitable.
[0022] If it is a porous hollow fiber, although it will not limit especially as a hollow fiber used for the hollow fiber module of this invention, the quality of the material of polyethylene, polypropylene, a

polysulfone, polyether sulphone, polyvinyl alcohol, a cellulose acetate, a polyacrylonitrile, and others can be chosen. Although not limited especially about the pore size on the front face of a hollow fiber, either, expedient selection can be carried out within the limits of 0.001 micrometers - 1 micrometer. Moreover, although not limited especially about the outer diameter of a hollow fiber, either, the rocking nature of a hollow fiber is high within the limits of 250 micrometers - 2000 micrometers, and since it excels in washing nature, it is desirable.

[0023] moreover, between housing and hollow fibers -- liquid -- it limits especially about the adhesives pasted up densely -- having -- a bur -- thermosetting resin, such as an epoxy resin and a urethane resin, can be used preferably A protection cylinder is the structure which encloses the periphery of a hollow fiber bunch, and especially the fixed method is not limited. It is appropriate to fix in a module with adhesives with a hollow fiber bunch, or to paste the inside of housing preferably.

[0024] Although the configuration of a protection cylinder will not be limited especially if it is a configuration which can surround the periphery section of the hollow fiber bunch with which it has loaded into a module, a cylindrical shape is preferably suitable for it. A cylindrical shape means what is the configuration to which the configuration of the cross section which intersects perpendicularly with a shaft applies to circular, an ellipse form, or this. By the protection cylinder of this cylindrical shape, the injury on the hollow fiber by contact to a protection cylinder and a hollow fiber can be reduced.

[0025] Especially a configuration will not be limited, if the cylindrical surface of this protection cylinder makes a closed side preferably even the position within the limits of 10mm - 60mm at least 10mm from the inside of an adhesion fixed part, and a fluid flows out and bends and makes it a configuration. What was made into the configuration where the soffit section of a cylindrical shape was preferably cut aslant at about 30 degrees like the configuration cut off in part as opening, especially drawing 1 to the direction which intersects perpendicularly with a shaft is good.

[0026] Moreover, what prepared opening which becomes the protection cylinder of a cylindrical shape from many holes like drawing 2 may be used. The cylindrical surface prepares opening which make from an adhesion fixed part inside to at least 10mm into a closed side, and it is made for there to be no inside-and-outside movement of a fluid, and consists of many holes under the closed area, and can be made to perform inside-and-outside movement of a fluid.

[0027] In having made the closed side length of a protection cylinder shorter than 10mm from the adhesion fixed part inside, it becomes difficult to make air **** near an adhesion fixed part. Moreover, per module cross section, and 0.1-5.0m3 / m2 usually supplied in a module when closed side length is made longer than 60mm and it is the structure where a fluid flows out If it is a supply flow rate, since air **** can be made, the demerit which decreases the effective film surface product which contributes to filtration is large.

[0028] As the quality of the material of a protection cylinder, although any of a metal and a resin are sufficient, resins, such as acrylic resin from a viewpoint which lessens the injury on a hollow fiber, vinyl chloride resin, a polysulfone, a deformation polyphenylene oxide, and polycarbonate resin, are desirable.

[0029]

[Example] The hollow fiber bunch which consists of 3500 polyacrylonitrile porosity hollow fibers of example 1 outer diameter of 680 micrometers, the bore of 400 micrometers, and 0.01 micrometers of average pore size is bundled in the shape of U character. With the hollow fiber bunch which inserted the both ends in the protection cylinder which prepared the hole in the position of the edge by the side of an adhesion fixed part to 15mm, and prepared eight pieces in eight pieces and the position of 30mm with the outer diameter of 85mm, and the bore of 82mm, and bundled this protection cylinder in the shape of U character After inserting into housing with an outer diameter [of 110mm], and a bore of 104mm of a rigid-polyvinyl-chloride pipe and fixing the one end section with adhesives, a part of the adhesion fixed part was cut, and opening of the interior of a hollow fiber was carried out.

104 − 85 = 19 / 2 = 9.5 mm

[0030] Moreover, the protection cylinder at this time is the length extended from the adhesion fixed part to 40mm, and has been arranged to the segment which passes along the position of the hole (opening) of a protection cylindrical surface from the protection cylinder cross-section center O centering on the

h g cg b eb cg e e

entrance of the air exhaust port of housing into the portion which removed the field of the range of **30 degrees right and left from the center O. Moreover, it is 2 60mm of gross areas to the lower part of housing. The air injection section which has eight injection tips has been arranged horizontally, and the hollow fiber module of a length of 1100mm of a configuration as shown in drawing 2 , and 800mm of hollow fiber effective length was manufactured.

[0031] Although filtration operation which makes [30l. the pure water for /] 1 cycle air scrubbing and drainage for 30 seconds for 1 minute for 30 seconds for water supply, the filtration for 13 minutes, and 30l. the air for /was continuously carried out for two months to this hollow fiber module, the damage on a hollow fiber was not generated near the adhesion fixed part.

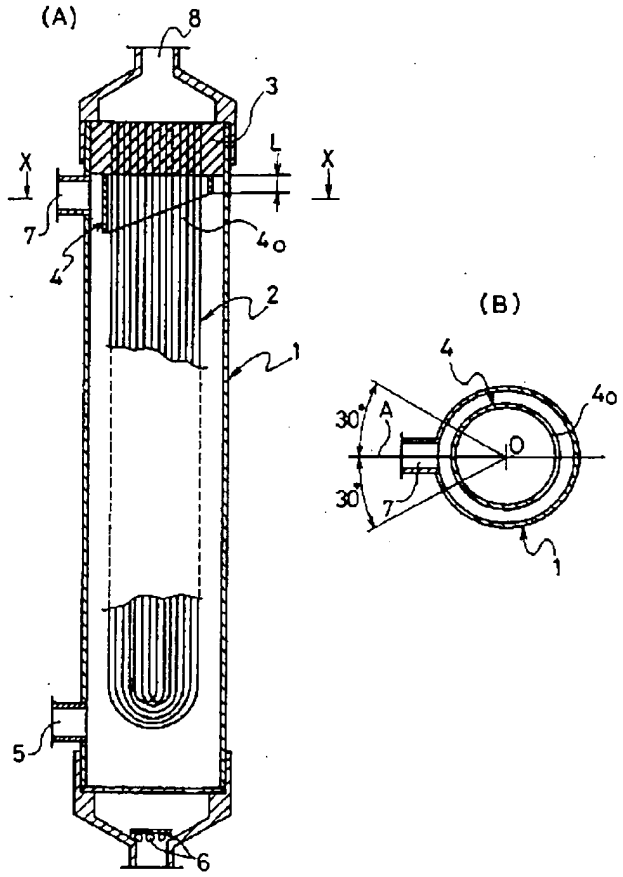
[0032] The hollow fiber bunch which consists of 3500 polyacrylonitrile porosity hollow fibers of example 2 outer diameter of 680 micrometers, the bore of 400 micrometers, and 0.01 micrometers of average pore size is bundled in the shape of U character.

* NOTICES *

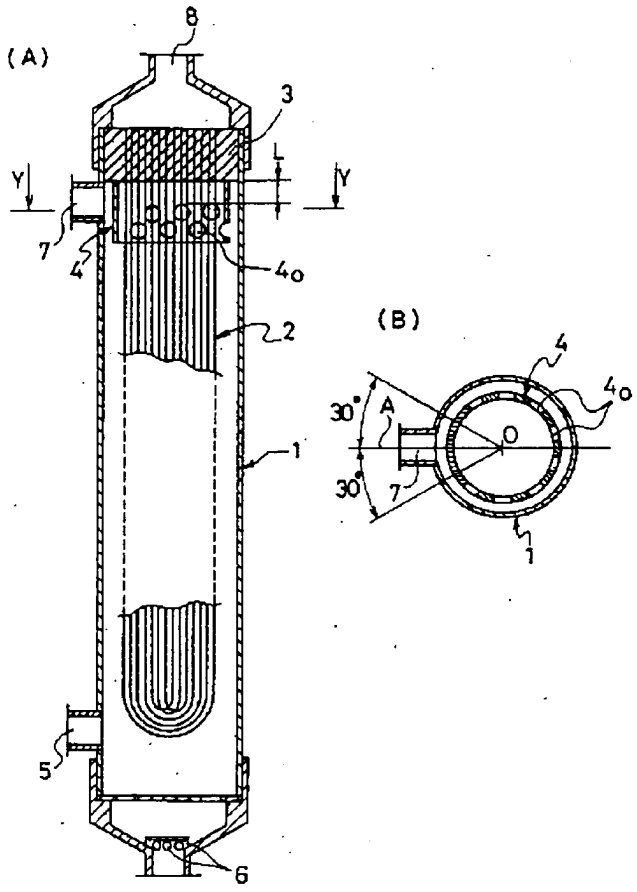
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]

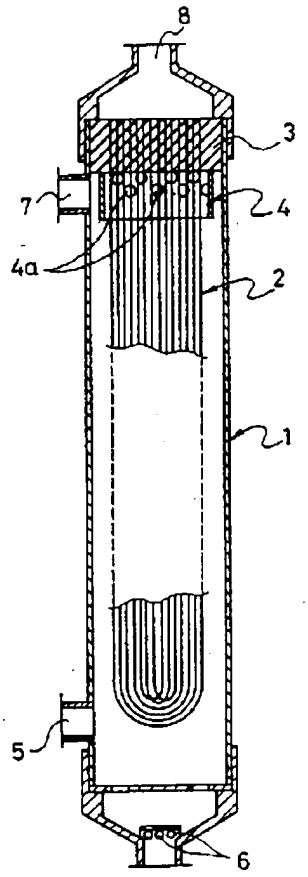


[Drawing 2]



[Drawing 3]

h g cg b eb cg e e



[Translation done.]

h g cg b eb cg e e